BIOLOGY LEADERSHIP CONFERENCE 10
POSTER SESSION ABSTRACTS

A Poster 1

Blogging as an Assessment Tool for a Research-Based Introductory Biology Lab

TAMARAH ADAIR, *Baylor University*

Over the past 3 years we have implemented a research-based laboratory for incoming freshman biology students. One way in which we are assessing the results of this program is through a required blogging activity. The BEARS in the SEA blog collects the thoughts of 24 students during a sharp learning curve and completion of a scientific discovery. Students were told to blog regularly during the fall and spring semesters about any topic concerning the course. The course consists of a wet lab portion in the fall, in which bacteriophage are collected and analyzed, and a genomics portion in the spring, in which the genome of one newly discovered bacteriophage is sequenced, fully annotated, and submitted to GenBank. What can we discover about student learning by analyzing these blogs? The qualitative research software NVivo, is used to classify and analyze recurring themes found in the student comments. This poster will outline the mechanics of using NVivo for this type of investigation and the preliminary results that have been obtained.

B Poster 2

The Perfect Storm for Reform

ELIZABETH ALLAN, *University of Central Oklahoma*

The University of Central Oklahoma (UCO) was founded in 1890 as the state's first public institution of higher learning. The biology department is the largest in the college and has over 900 majors taught by 30 full-time faculty members. The biology core curriculum sequence was developed in response to poor student performance in upper-level biology courses, and begins with Biology For Majors. When first developed, the course was similar to most beginning biology courses. There was too much content and there were too few meaningful interactions with the curriculum. The course quickly became one of the most failed courses in the university (mean failure rate > 50%). Three events – the development of an introductory course with a low success rate; a CUR review that revealed the need for a stronger, more robust core; and the necessity of developing and implementing an assessment system – resulted in significant changes in the Biology 1204 curriculum and in the way in which faculty teach the course and consequentially, how students experience the course. Those changes and the process through which change occurred are described here.

A Poster 3

The Valle Verde Living Lab and Native Cactus Garden as a Catalyst for Faculty and Student Collaboration, Engagement and Innovation

carlos amaya and dominic lannutti, *El Paso Community College*

As a consequence of the lack of adequate laboratory space and the need for the addition of specialty classes such as Botany, Environmental Science and Research Techniques, Biology faculty were forced to think outside the traditional lab setting in order to be able to offer such classes. The creation of the Valle Verde Living Lab (an urban community garden) and Native Cactus Garden allowed faculty to introduce students to basic gardening techniques, native flora, and the biological concepts involved in these systems. The incorporation of the gardens into the course curriculum also allowed students to apply the concepts gained in lecture and reinforced students' mastery of learning outcomes required for each of the courses. The creation and subsequent sustainability of the garden is a direct result of student and faculty interaction and collaboration. The students have been instrumental in creating these alternative lab spaces and have in turn shown a greater level of engagement as well as innovation in terms of their projects and future endeavors.

B Poster 4

Overcoming Freshman Trauma: Engaging New University Students in Large Classrooms

brian antonsen, *Marshall University*

Marshall University's science students face several challenges in addition to the rigors of STEM coursework when they arrive for their freshman year. A large number are first-year college students and many are from economically disadvantaged families and regions. As faculty, especially in our large introductory courses, our ability to engage these students is constantly tested. However, we also have a tremendous opportunity in identifying and mentoring some extremely talented students who have not yet begun to realize their full potential. In our introductory biology courses, we have implemented several techniques and initiatives to help us connect with students and raise their achievement levels. These include use of automated classroom response systems, online learning tools, and a Learning Assistant program that encourages talented advanced undergraduates and freshmen to interact with and learn from each other. The sum total of our learning from these efforts is: lack of student self-engagement is a (or the) major obstacle to learning at our university, and the best way to overcome this is use of tools or techniques that help engage students and encourage them to push themselves in a meaningful way.

A Poster 5

Using Student Learning Outcome Results to Predict Student Success in Introductory Biology

ANDREA S. ASPBURY, *Texas State University, San Marcos*

Student learning outcomes (SLOs) are statements that specify what students will know, be able to do or be able to demonstrate when they have completed a course, or parts of a course. SLOs are usually expressed as knowledge or skills, and they specify an action by the student that must be observable, measurable and possible to demonstrate. I propose to use the SLOs that are linked to MasteringBiology® content to measure student success in a large introductory course for Biology majors. I will determine the percent average score on 10-20 learning outcomes for each of 3 units taught during each semester-long course. I will then examine the relationship between SLO success and exam success for each of the 3 units, as well as for the comprehensive final exam. This study will be replicated across instructors and sections of the course for 3 years. Preliminary data suggest that there is a negative relationship between student success on exams and student success as measured by SLOs.

B Poster 6

Using Major Principles for Matter and Energy and Natural Selection in Introductory Biology

PAUL BEARDSLEY, *California Polytechnic, Pomona*

Cognitive psychologists and science education researchers suggest that to develop expert-like thinking in a discipline, students need a deep factual understanding based on a coherent conceptual framework involving the major scientific principles of the discipline. Prior research highlights that high school and college students often fail to use major scientific principles associated with energy and matter (e.g. Wilson et al. 2006) and natural selection (Nehm and Reilly, 2007). To address these concerns, the first quarter of the Foundations of Biology series focuses on the themes of energy, matter and evolution. To help students use major principles of energy and matter, we replicated the approach of Wilson et al. (2007) and asked students to trace matter and energy in systems throughout the course, among other pedagogical approaches. Preliminary results show large student gains in using major concepts in matter and energy. Additionally, we attempt to integrate evolution into every topic covered in the course, starting with relevant, recent examples of natural selection in humans. The "evolution chapters" are not a part of this first quarter course, but students are asked to apply the major principles of natural selection in multiple contexts. Preliminary results suggest strong student gains, even for concepts involving prominent misconceptions.

A Poster 7

Report on a Flipped Introductory Biology Course

SCOTT BOWLING, *Auburn University*

Flipped courses emphasize introduction of content outside of the classroom and focus on active learning in the classroom (and outside of it as well). A flipped course format was used for two large sections of a first-semester introductory biology course. Key preparation learning tools included lecture notes and lecture slideshows as well as the textbook, and MasteringBiology homework assignments due before class. Various active learning activities were used in the classroom, including clicker quizzes, think-pair-share, group exams, and "redux" exams (new exams on the same material, allowing students two exam attempts on the material). Student scores on the comprehensive final exam for the flipped course were significantly higher than the scores from a comparable semester of the course with a more traditional format. A flipped course format is now being implemented for the second course in the two-course introductory biology series.

B Poster 8

Mini-Field Trips Promote Observation and Questioning

RUTH BUSKIRK, *University of Texas, Austin*

Hands-on exposure to organisms in laboratory and field settings promotes student learning but is not part of our large-enrollment introductory biology course. I offer optional 'mini fieldtrips' to have students become more aware of organisms on campus and relate their observations to topics discussed in lecture class. Students can join me for fifteen minutes at a specific location on campus at one of several announced times (2-25 students generally show up), and we look at some aspect of the local flora and fauna. After students observe and describe patterns they see, I pose a question. Students suggest possible answers and approaches with which that question could be answered. Some examples: Does the presence of ball moss harm trees? What do turtles do when ice forms on the pond? Why are some of these trees in bloom already? Days and weeks later, even in later semesters, students come up to me and report things they have seen on their own. These popular mini-field-trips help students learn how to observe and ask testable questions, and I don't have to give them a single point to promote higher thinking.

A Poster 9

Teaching Introductory Biology in a SCALE-UP Format: Student Perceptions and Lessons Learned

JEFF CARMICHAEL, *University of North Dakota*

The department of biology at the University of North Dakota (UND) now teaches all of its introductory and core required courses in a new SCALE-UP classroom (student centered active learning environment for undergraduate programs). This study compares performance and perceptions of learning gains of introductory biology students taught

in a traditional lecture-bowl setting with students taught in the new SCALE-UP classroom. Overall average exam performance was comparable among students taught in the lecture-bowl and SCALE-UP settings. However, there was a higher percentage of "A"s and "F"s in the SCALE-UP classes than in the lecture bowl classes. Students in both class settings reported significantly higher learning gains for using the scientific method, interpreting data, having a grasp of major concepts, and being interested in those topics after taking the class than beforehand. Interestingly, students in the SCALE-UP setting ranked the effectiveness of in-class active learning activities relatively low compared to lectures and team-based quizzes. However, SCALE-UP students reported higher levels of engagement with the course and felt that the class setting helped them think more deeply about the subjects than lecture alone. These results have implications for instructors thinking about converting their classes to a SCALE-UP format.

B Poster 10

Taking it Outside: Investigative Biology as a Means of Teaching Ecological Principles

REBEKAH CHAPMAN, *Georgia State University*

Ecological principles are often taught in a theoretical framework in the typical lecture for introductory biology and even upper level ecology courses. We have taken an integrative approach by having labs that are in line with the ecology course and that have student-led investigation at the core of their development. Students are introduced to concepts in the classroom, and then they design experiments to test major hypotheses in the lab. Students also participate in daylong field labs during which they study the principles of community ecology by assessing forest and stream habitats. Their research papers are shared with the conservation group that manages the land associated with these stream and forest habitats, and students have opportunities to return for monthly monitoring. Presenting students with the materials but having them develop the research questions and analyze real-world data they are collecting has been very effective in helping them master associated concepts. They are more engaged and excited about the material in class and demonstrate improved mastery on assessments.

A Poster 11

Flipping a Large Introductory Biology Class, Round 2

JUNG CHOI, *Georgia Institute of Technology*

In fall 2011 and 2012, I taught two large lecture sections of our Intro Biological Principles course using an inverted or "flipped" classroom model. For fall 2012, I constructed a class web page and open education resource: *http://bio1510.biology.gatech.edu/* that summarizes essential points, with 5-10 min embedded video lectures that explain key concepts, and in-class activities that apply these concepts. Students completed homework assignments in Mastering Biology before the concepts were addressed in class. Clicker questions at the start of the class period provided retrieval practice or addressed common misconceptions. For the majority of class time, students worked in small groups on problems and case studies. The in-class activities ended with clicker questions that probed student results and understanding from the activities. More details may be found on my blog: the page "Intro Bio Topics" (*http://jchoigt.wordpress.com/intro-bio-topics/*) lists posts outlining many of my in-class activities. Analysis of tests showed that student performance on factual recall

questions was unchanged from prior years (2009-2010), but that performance on application/analysis questions improved. Student reactions were still mixed at the end of 2012. Some student thrived in the flipped classroom environment; others expressed resentment. Student evaluations of my teaching for the flipped class had significantly lower mean ratings compared to previous years.

B Poster 12

National Experiment in Undergraduate Science Education (NEXUS) — Teaching and Assessing a Competency Based Science Curriculum with Case Studies

MICHAEL GAINES, *University of Miami*

The Howard Hughes Medical Institute (HHMI)-funded National Experiment in Undergraduate Science Education (NEXUS) is a pedagogical experiment to create and evaluate new competency-based teaching modules for undergraduate life science education. This curriculum is designed to help students achieve mastery of eight science competencies outlined in the 2009 American Association of Medical Colleges (AAMC) – HHMI *Scientific Foundations for Future Physicians* (SFFP) report and also to help students gain an interdisciplinary perspective on biology. These competencies integrate biological concepts with principles of chemistry, mathematics, and physics. NEXUS is a collaborative effort among Purdue University, University of Maryland Baltimore County, University of Maryland College Park, and the University of Miami (UM) with each institution designing a unique part of this innovative curriculum. At UM we have developed case studies that are tightly aligned with the SFFP competencies. The case studies present real world situations through narratives. As students read through the story, they answer associated questions drawing upon cross-disciplinary knowledge and an integrative understanding of scientific concepts. We have developed eight case studies thus far: Bad Blood, Diabetes, Evolution, Freediving, Milk, Ocean Acidification, Smart Pills, and Strep Throat. We use student performance on case studies and their feedback on surveys to gauge student mastery of the SFFP competencies.

A Poster 13

Do Biology Labs Matter? Comparing Learning Gains, Class Performance and Science Attitudes in Introductory Biology Students

NANCY GUILD AND CHRISTY FILLMAN, *University of Colorado, Boulder*

Class performance, learning gains and science attitudes were compared in students enrolled in the introductory molecular cellular and developmental biology course (MCDB 1150) at the University of Colorado, Boulder. Most students who enroll in this course (majors and non-majors) take the traditional lab course that accompanies MCDB 1150. Some students only take the lecture course and a small subset of MCDB 1150 students take a research-based introductory lab course, the phage lab. We compared the course learning gains in these lab groups and included students who applied but did not enroll in the phage lab. Both phage students and phage lab applicants had higher-class performance and learning gains than the other lab groups. The traditional lab students had higher learning gains than the non-lab students, even though the lab course and curriculum is separate from the lecture course.

B Poster 14

Teaching Backwards, Naked and Flipped: What do Students Feel Helps Them Learn?

ANGELA HODGSON, *North Dakota State University*

To improve student understanding and knowledge retention, many innovative teaching methods have been proposed during the last decade. Many of these methods are aimed at making the process of teaching more intentional and/or the classroom more active. During the past four years, I have been working to incorporate many of these new approaches to teaching into my large-enrollment (> 300 students) Introductory Biology courses, including Backward Design, Teaching Naked and the Flipped Classroom. Using the Backward Design framework of Wiggins and McTighe (2005), I have organized my first semester introductory biology course around 5 "Big Questions" and their associated learning outcomes. Embracing the "Teaching Naked" philosophy of José Bowen (2011), PowerPoint slides are only used to show important pictures; most class time is spent on annotating figures, data and graphs, on active learning activities, or in discussion. In order to make time for more active learning in my classroom, I am also employing the "flipped classroom" model (Lage and Platt, 2000), which requires students to read before coming to class and, often, watch a pre-recorded video lecture. So, do any or all of these techniques contribute to student learning? While I am currently analyzing assessment data from a variety of sources, this poster will present the viewpoint of the student. For the past two years, I have asked the students how they think each of the classroom techniques or resources that I use contributes to their learning. An analysis of these data will be shown.

B Poster 38

Improving Scientific Thinking and Experimental Design Skills in Undergraduate Students

ANGELA HODGSON, *North Dakota State University*
FIONA RAWLE, *University of Toronto at Mississauga*

In the past decade there have been important national calls for changes in the way we educate biology students in order to improve scientific literacy and better prepare them to practice biology in our highly technological world (NRC, 2003; AAAS, 2011). These reports highlight the importance of incorporating explicit scientific process skills training throughout the biology curriculum. Our project, which was funded by a Catalytic Grant, was designed to provide a framework for incorporating the teaching of scientific process skills into the lecture and lab of large enrollment introductory biology courses. At the University of Toronto-Mississauga, scientific thinking instructional modules were designed and incorporated into the lecture component of the introductory biology course, while at North Dakota State University, inquiry labs emphasizing scientific thinking were incorporated into the laboratory component of the course. To assess the effectiveness of our curricular changes we used the Experimental

Design Ability Test (EDAT) as a pre- and post-test to measure scientific thinking learning gains. We will discuss the results from these pre- and post-test measurements.

A Poster 15

Teaching to the Test...or Testing to Teach: Exams Requiring Higher Order Thinking Skills Encourage Greater Conceptual Understanding

JAMIE JENSEN, STEEN WOODARD, AND TYLER KUMMER, *Brigham Young University*
MARK MCDANIEL, *Washington University, St. Louis*

In order to test the effect of exam format on students' conceptual understanding, low-level and high-level quizzes and exams were given and analyzed in two sections of an introductory biology course. Each section was taught in a high-level inquiry-based style but was assigned either low-level, recall-type quizzes and exams, or high-level deep conceptual understanding quizzes and exams for the entirety of the semester. A single final exam consisting of 20 low-level and 21 high-level questions was given to both sections. We hypothesized that high-level exams would encourage deeper processing of the information by students in preparation for the exam and predicted that this would lead to greater understanding as demonstrated by higher scores on a common final exam. Results showed that students taking high-level exams demonstrated higher recall of information as assessed by low-level items on the final exam as well greater deep conceptual understanding as assessed by high-level items on the final exam; this lends support to the hierarchical nature of Bloom's taxonomy and the influence of assessment format on student learning. Implications of transfer-appropriate processing and the testing effect are also discussed.

B Poster 16

Vidyo: Using High Definition, Multipoint, Online Video Conferencing in the Biology Classroom

CHARLES KAZILEK, *Arizona State University*

Investigating the possible uses for high-definition, multi-point, low-latency video conferencing in teaching and learning. Possibilities include outside speakers brought into the classroom, collaboration with distant peers, collaborative student projects, and online field trips. This poster will review the technical specifications, preparation, technical issues, and costs.

A Poster 17

Introductory Biology Interventions and Active Learning Improve Student Learning and Decrease Student Withdrawals

ANITA MANOGARAN, MICHELLE MYNELIEFF, MARTIN ST. MAURICE, AND THOMAS J. EDDINGER, *Marquette University*

In large enrollment classes, there is concern whether the wide variety of students retain information that they have learned. In recent years, many instructors have begun to integrate alternative methods such as classroom response systems in hopes to increase student learning. Here, we have assessed how certain "interventions" such as peer-reviewed writing assignments, use of a classroom response system, and exam corrections improve student learning. Taking advantage of our three-section introductory biology course, we designed an experimental study to test the possible benefits of these approaches using control and experimental variables across and between sections. Based on our assessment, students scored higher on topics learned via peer reviewed writing assignments relative to learning in an active classroom discussion, or traditional lecture. Additionally, students who corrected exam questions that they answered wrong showed significant improvement on post-exam assessment compared to their non-participating peers. Additionally, analysis of historical data indicates integration of these interventions have significantly decreased student withdrawal rates. Our data shows that these interventions have significant student learning benefits with only moderate additional effort by instructors. It is envisioned that these interventions can be easily incorporated into any biology course, with similar significant improvement in learning outcomes and student retention.

B Poster 18

PULSE Partnerships for Change: Moving from "Vision" to "Change" in Undergraduate Life Science Education

JENNY MCFARLAND, *Edmonds Community College*

What will it take to bring about the necessary transformation of STEM higher education described in *Vision and Change*? PULSE (Partnership for Undergraduate Life Sciences Education) is a joint effort by National Science Foundation (NSF), National Institutes of Health (NIH) and Howard Hughes Medical Institute (HHMI) to stimulate systemic changes within biology departments at 2-year and 4-year colleges and universities, based on the 2011 report *Vision and Change in Undergraduate Biology Education* and other calls for transformation of life sciences education. We have the change mandate (the problem). We have the change evidence (the solutions). We now must implement and institutionalize, specifically at the departmental level, teaching practices that provide for the 21st century *Vision and Change* learning outcomes. The PULSE Leadership Fellows are tasked with facilitating pathways to foster change in undergraduate life science education. This poster will share the projects of the four PULSE sub-groups and our efforts to network with other groups who have a long history of doing this work, including the BLC.

A Poster 19

Getting at the Important Ideas in Metabolism Using Models

JOHN MERRILL, *Michigan State University*

For many years my co-instructors and I have encouraged our students to focus on the important practices of tracing matter, tracing energy, and tracing information in complex biological processes. In relation to cellular respiration and photosynthesis, we repeatedly remind students to pay attention to "what goes in", "what comes out" (tracing matter) and "what are the energy relationships" (tracing energy). Here we report on the use of simplified, student-generated, box-and-arrow diagrams as an effective tool in

encouraging students to set aside their seemingly intractable habit of memorizing details in favor of a bigger picture/systems approach. Students are tasked with reducing a process to one or a few boxes connected by arrows, for example, "Draw a simple box on a sheet of paper to represent the entire process of Glycolysis. Add arrows to indicate inputs and outputs of glycolysis, labeling each one. Use open arrows to indicate energy management molecules, and closed arrows to indicate other inputs and outputs such as substrates and products." Although we are unable to assess their models individually because of the very large number of students (400-500 per section), a closely coupled set of clicker questions is able to probe the outcomes surprisingly well. Preliminary exam data suggest improved summative outcomes.

B Poster 20

A (Painful) Homework Assignment

PETER MINORSKY, *Mercy College*

I was recently asked by a professional society to help them in answering a query they had received from a university librarian concerning a specific internet quotation concerning whether plants feel pain. As I perused internet sources relating to "plant pain," I soon realized that many of the studies, researchers, and quotations relating to this subject were fictional. Two quotations, in particular, have been widely disseminated across the web.

#1 "Researchers from Michigan State University have also recently discovered that plants have a rudimentary nerve structure, which allows them to feel pain."

#2 "Plants not only seem to be aware and to feel pain, they can even communicate."

Ultimately, I traced these two widely disseminated quotations to two online lampoons! Although I had wasted several hours of my life tracking down the original sources of these "lies," it occurred to me that my endeavors might find some utility as a pedagogical exercise aimed at reinforcing, in students' minds, the need for skepticism in accepting all internet information as factual. I present a series of queries that should lead students to the ultimate sources of these quotations.

A Poster 21

Increasing Student Success Using Online Quizzing

REBECCA ORR, *Collin College, Spring Creek Campus*

According to a 2012 ACT report; only 31% of students demonstrated the level of science expertise needed to succeed in an entry-level college course. Additionally, many students lack the study skills necessary for success in an introductory biology course for science majors. We find that frequent use of required pre-exam online quizzing is effective in increasing students' ability to retrieve information. Simply taking 100% of the offered quizzes resulted in a significant difference of 9-11 points above those students who do not take quizzes, even if the students did not do well on the quizzes themselves. The benefit of quizzing is demonstrated to be significant for students of diverse academic abilities. In the Fall 2012 semester, efforts were successfully made to significantly increase student compliance with required quizzing. A significantly higher percentage of ABC vs. DFW grades was observed, as well as a significant improvement in

class exam averages as the semester progressed. Pre-exam quizzing using an online homework platform is an effective way to increase student success and allows class time to be utilized for teaching activities.

B Poster 22

Drawing to Learn: A Conceptual Framework to Guide Best Practices

KIM QUILLIN, *Salisbury University*

Do students learn more when they make their own diagrammatic drawings as formative exercises in biology? The answer turns out to be complicated: *it depends*. To help make sense of the variability in the data, I developed a conceptual framework combining sources of variability in drawing experiences with types of cognitive load. I then used this conceptual framework as a starting point for identifying variables that might be particularly good predictors of success or failure (in terms of learning gains) in drawing exercises. To test my first set of predictions, I conducted a survey in an introductory biology course to measure student experiences and perceptions before and after a drawing exercise on natural selection (N=175), validated by think-aloud interviews (N=14). I will present my preliminary results at the BLC. The overall goal of this work is to develop a set of best practices to guide the use of drawing exercises. Further, the conceptual framework developed for drawing is applicable to other types of process skills such as writing and oral communication.

A Poster 23

Curriculum Mapping in Biology Education: Aligning Curriculum Goals and Assessing Outcomes

FIONA RAWLE, *University of Toronto at Mississauga*

Our department initiated an ongoing Curriculum Mapping Project (CMP) three years ago. The CMP has multiple goals, including: (1) to establish a curriculum framework that will act as a resource to facilitate learning outcome alignment; (2) to facilitate the increased integration of our curriculum, and to encourage continuity across courses and across years; (3) to facilitate an increased use of backwards design in new course design; (4) to facilitate curriculum assessment; (5) to identify gaps in achieving program learning outcomes; (6) to guide future program reform; and (7) to facilitate overall critical reflection about the program curriculum. This poster will showcase some maps that have been generated through the CMP and will detail the process used to gather, document, and share curriculum data.

B Poster 24

Undergraduate Teaching Assistants Help Bridge the Gap Between

Faculty and Students

LAUREL ROBERTS AND JACALYN NEWMAN, *University of Pittsburgh*

College students are often reluctant to seek help from faculty until the term is nearly over. Faculty, meanwhile, often find it challenging to meet the educational needs of the hundreds of students they instruct in large introductory classes. At the University of Pittsburgh, many biology faculty use undergraduate teaching assistants (UTAs) to help answer student questions, develop student-focused active learning materials, and facilitate small group review sessions in dormitories. Managing a team of UTAs is challenging but worth the effort. The UTAs report increased mastery of biological concepts, speaking skills, and a feeling of being partners with other UTAs and faculty. Students benefit from having their near-peers explain confusing concepts and relate how these concepts will be used in future courses. Faculty benefit from the infusion of new approaches to reviewing concepts they themselves mastered years ago, and also receive feedback from UTAs as to what are the most frustrating topics for students. This poster will describe our Bio In the Dorms (BID) program and other techniques that we have developed to make best use of this previously untapped resource.

A Poster 25

Improving Student Performance in General Biology

JOAN SHARP, *Simon Fraser University*

A National Science Foundation-funded study headed by Co-Principal Investigators Scott Freeman and Mary Pat Wenderoth at the University of Washington is investigating whether increased course structure can close the achievement gap between underrepresented minority students and other students. In addition to University of Washington, five other institutions are participating in this study: Simon Fraser University, University of British Columbia, Eastern Michigan University, Everett Community College, and California State University–Fullerton. At SFU, our goal is to test whether increasing course structure, by increasing active learning activities during lecture periods, can improve student performance and whether this improvement is greater in students with reduced English language fluency skills.

I am teaching two lecture sections of General Biology BISC 102. In both sections, students complete daily reading quizzes based on assigned text readings. Both lecture sections include existing active learning components: clicker questions and clicker-cases with small group discussion. The remainder of the material in the control lecture section will be delivered in traditional lecture format, while material in the experimental lecture section will be learned by students working alone, in pairs, and in small groups to complete worksheets, answer additional clicker questions, and work through problem sheets and case studies. Teaching assistants and instructors move around the classroom to assist students and student groups. Students and student groups are called on as volunteers, from a randomized class list or by clickers to respond to questions or to summarize solutions to the problems they have been working on. Students in both lecture sections are combined in lab and tutorial sections. Both lecture sections write similar midterm exams and write an identical final exam together.

B Poster 26

Fueling a Passion for Discovery through Blogging in Undergraduate Science Courses

JILL SIBLE AND GARDNER CAMPBELL, *Virginia Tech*

A good undergraduate science program enables its students to develop scientific minds filled with disciplinary knowledge and analytical tools. Add in an excellent research experience, and a student assumes the soma of a scientist, technically adept and with the stamina for exhausting investigations. But how does one cultivate the *soul* of a scientist – a person of unquenchable curiosity and reverence of Nature? For this last outcome, a new medium may be required, one less bounded by scientific and academic conventions. At Virginia Tech, students in cell biology classes blogged weekly about anything related to the course. A rich profusion of personal reflection resulted, one that links living and learning in reflections such as the informal sharing of scientific knowledge when a student in the class explains to her friend why she feels faint after a workout. These narratives form an auto-ethnography of the growing scientific imagination. By sharing these narratives, students experience a community of practice and curiosity as expressed in more personally authentic reflection. Students engage in the elaboration that identifies as a crucial part of deep and integrative learning. The practice of blogging in undergraduate science courses has exceeded the expectations typically held for new learning technologies. The blogs may or may not facilitate better memorization, retention or recall, but they certainly promote independent scientific inquiry, integration and evaluation. Initially students may blog because it is required; however, somewhere along the way, most students blog because they must – because they have become scientists with something to say!

A Poster 27

Hands-On Restoration at LUREC

BREE SINES, *Loyola University*

Loyola University Chicago is fortunate enough to have an Ecology and Retreat campus located 50 miles west of our Lake Shore Campus. This parcel of land includes diverse habitat, like an oak-hickory woodland, an oak savanna, and a calcareous fen. Many biology classes have directly participated in the planning, research and restoration of the LUREC habitats. This hands-on approach has allowed many students the opportunity to learn the ecological, political, and social aspects of restoration. Students have been able to experience a wide range of opportunities, from measuring the species richness of birds at LUREC to publically presenting their restoration plan to fifty people at a luncheon. The goal of the LUREC restoration is to continue to keep the students involved in all aspects of the restoration work. Students will create, research and witness the transition of a buckthorn-dominated wetland to a highly diverse and functioning calcareous fen.

B Poster 28

Flipping the General Chemistry Classroom

MATTHEW STOLTZFUS, *Ohio State University*

The "flipped" classroom has received much attention recently among educators as an innovative method to improve instruction in order to make the classroom more student-centered (Bergman and Sams, 2009; Morgan, 2011; Overmeyer, 2010). In brief, the flipped classroom makes use of video/screen capturing technology to capture content rich lectures, making them student homework. As a result, formal lecture time in the classroom is drastically reduced, allowing a more active learning environment consisting of demonstrations, problem-based learning, critical thinking etc. to be introduced without sacrificing precious instructional time to lecturing. The flipped classroom is not a specific prescriptive methodology to teaching; instead, flipping the classroom is focused on the learning activities that occur in the classroom beyond traditional lecture. The flipped classroom discussed in this presentation was implemented in large (N > 300) university lecture classes. The aim of this presentation is to discuss best practices and challenges of implementing the "flipped" classroom in general chemistry and how to administer a "flipped" chemistry classroom at the high school or university level.

A Poster 29

MSU's Massive Open Online Course on the Foundations of Science: Education for the Community & the Community for Education

STEPHEN THOMAS, *Michigan State University*

Michigan State University has received a grant from the Gates Foundation and Desire2Learn to produce a Massive Open Online Course entitled Foundations of Science. The Foundations of Science MOOC focuses on the development of fundamental critical-thinking and reasoning skills that can serve as a basis for increasing students' effective decision making about science.

Development of the course has been open to University faculty, who can view objectives and content and can also design research questions to test the efficacy of this new educational model. The funding from the Gates Foundation and Desire2Learn has catalyzed a discussion at MSU by providing funding not only for the development of the MOOC but also for nine part-time graduate fellowships. The University, in response, has provided two graduate fellowships dedicated to course assessment and student diversity / accessibility and has also provided support for a graduate-level course to train faculty and graduate students in online pedagogy. To facilitate campus discussion about MOOC philosophy and pedagogy, we have also created a University study group with over fifty faculty, staff, and students involved. This group holds ongoing discussions about the challenges we face and the lessons learned in the production of the MOOC and the community surrounding it.

B Poster 30

Putting it All Together: Using Active Learning and Graduate TA Training to Enhance Undergraduate Biology Education

BINABEN VANMALI, CHRISTIAN D. WRIGHT, KEGAN REMINGTON, KATHY HILL, AND MILES ORCHINIK, *Arizona State University*

To create more scientifically literate citizens and the next generation of life sciences professionals, the School of Life Sciences at Arizona State University is transforming the way we teach undergraduates and train graduate teaching assistants (TAs). To facilitate these transformations, we have implemented several key measures designed to improve teaching and learning. We built an interactive, student-centered Active Learning Classroom (ALC) in which students share touchscreen PCs and access to four projectors, providing a Just-in-Time context. The ALC sessions are paired with large lecture courses and enable student-centered, inquiry-driven learning that uses activities based on cases, real data, simulations, models, etc. These small collaborative learning groups in the ALC are led by TAs trained with our Innovative TA (ITA) program. The ITA program boosts active learning within our classrooms and facilitates long-term changes in faculty teaching while also developing future faculty members who will excel at teaching *and* research. Faculty members submit proposals that indicate how ITAs will promote teaching innovation in large, upper-division core courses. ITAs complete a graduate course—*Scientific Teaching*—that introduces them to learning theories and collegiate science teaching with a focus on active learning strategies. The ITAs apply these theories and strategies to their classrooms.

A Poster 31

Modeling the Complexity of DNA Replication

SUSAN WARNER, *Community College of Baltimore County*

Students often struggle to understand DNA replication – not only the intricate process, but also the array of enzymes and the complexity of the system. Using a game of DNA replication races and getting the students up and moving seems to help. The students are assigned to play the role of each enzyme involved, and others bring in the appropriate nucleotides to the replication process. Having a race increases the challenge and gets the students more engaged. Mistakes are penalized, especially if they are not repaired by the repair enzymes. But they are the basis for evolution, so what the mistakes are and what is the consequence can be analyzed as well. This is a work in progress and can be made more or less complex as need be. The processes of transcription and translation will hopefully be added in the future.

Over the past 3 years we have implemented a research-based laboratory for incoming freshman biology students. One way in which we are assessing the results of this program is through a required blogging activity. The BEARS in the SEA blog collects the thoughts of 24 students during a sharp learning curve and completion of a scientific discovery. Students were told to blog regularly during the fall and spring semesters about any topic concerning the course. The course consists of a wet lab portion in the fall, in which bacteriophage are collected and analyzed, and a genomics portion in the spring, in which the genome of one newly discovered bacteriophage is sequenced, fully annotated, and submitted to GenBank. What can we discover about student learning by analyzing these blogs? The qualitative research software NVivo is used to classify and analyze recurring themes found in the student comments. This poster will outline the

mechanics of using NVivo for this type of investigation and the preliminary results that have been obtained.

B Poster 32

Training the Next Generation of Biodiversity Scientists at George Mason University

ANDREA WEEKS, *George Mason University*

The Undergraduate Biology Program at George Mason University launched its revised core curriculum in 2011 to update the essential set of concepts and skills each student receives in line with the recommendations of AAAS (2011). Faculty have designated evolution as a central concept for the new curriculum and have identified the ability to analyze, interpret and communicate scientific data as the skills most in need of strengthening among our majors. Two courses were created to incorporate new content and pedagogical strategies, such as weekly small group discussion sections (< 25 students), to achieve these programmatic goals. One of these, Biodiversity, covers essential information about the diversity of life at the organismal level that all biology majors should know. In the process of including biology content from other retired courses, we have added concepts that either were not covered or not emphasized by these former courses but that we believe are nonetheless essential for a liberal and 21st century education in biology. Moreover, in small group discussion sections, we have developed successful teaching strategies that are helping more students achieve fluency in written science communication and real-world statistical analysis of student-generated experimental data.

A Poster 33

Challenges in Developing an Online Biology Course with a Hands-On Laboratory

CAROLYN M. WETZEL, *Holyoke Community College*

Online course delivery is a fast-emerging area of higher education. Laboratory biological science courses are particularly challenging to convert to online format due to the historically and pedagogically important hands-on nature of the material. Biology is the study of life, and student interactions with a computer screen will never replace the experience they gain from physically handling living organisms and the tools used by biologists to study them. The challenge thus becomes how to incorporate meaningful hands-on experiences into an online course in which the student is working alone with only internet connection to the instructor and other students. My current research project is to develop such labs for an introductory biology class for non-majors and assess their effectiveness at meeting educational and institutional objectives. The course content will be organized around topics in life science that any member of literate society should be knowledgeable about, drawing from health, biodiversity, and the environment. The process of doing science by observation and hypothesis-based inquiry will be emphasized throughout. Presented will be a description of the challenges and possible solutions that I am exploring, and visitors will have a chance to participate in a survey.

B Poster 34

Evo in the News: Teaching Toward Student Understanding of the Relevance of Evolutionary Science

JASON WILES AND LYNN INFANTI, *Syracuse University*

This investigation evaluated the use of the pedagogical tool "Evo in the News" and its impact on attitudes toward and knowledge of biological evolution in a sample of undergraduate, non-major biology students at a large, private research university. "Evo in the News" is part of the *Understanding Evolution* website, which consists of a collection of articles and videos that link current evolution-based research to solutions to real-world problems. In addition, this study examined students' attitudes toward and knowledge of evolution at the beginning of a second semester introductory biology course. Both the initial attitudes and knowledge, as well as the changes, were measured using the Evolutionary Attitudes and Literacy Survey (EALS). At the conclusion of the semester, student participants in the treatment group showed significant improvement in EALS constructs regarding their attitudes toward evolutionary science and the relevance of evolution, and also in at least one evolutionary knowledge construct – that of genetic literacy. Additional findings demonstrated a significant correlation between positive attitudes toward evolution and knowledge of evolution. Also, significant correlations were found between student achievement and positive attitudes toward/knowledge about evolution.

A Poster 35

PLURIS: Purposeful Learning in Undergraduate Research and Independent Studies

KATHY S. WILLIAMS AND BROCK S. ALLEN, *San Diego State University*

PLURIS: Purposeful Learning in Undergraduate Research and Independent Studies PLURIS aims to improve the cost-effectiveness and academic consistency and auditability of undergraduate STEM independent study and research activities by designing experiences that clarify purposeful learning so that these activities can be offered to larger numbers and diversities of students. We propose that this process can be applied to many types of independent studies, such as completing research projects within courses, carrying out internship activities, and conducting supervised lab- or field-based research projects.

This project aims to help faculty and students: elucidate opportunities for learning in host projects and to recruit students; align individual student learning agendas with goals of supervising faculty or institutional requirements; clarify intended student learning outcomes; use clear assessment techniques to monitor and document actual learning outcomes. Expected outcomes include 1) providing a model to enhance current science education efforts within and beyond the university, 2) forming a collaboration among scientists, educators, and educational technology professionals to further

develop the science education expertise of STEM faculty, and 3) encouraging undergraduate, postdoctoral, and faculty researchers to think metacognitively about library-to-bench research experiences and learning in general. We are seeing all three happen, even in the project's early stages, in Biology and across departments and colleges at our university.

B Poster 36

An Innovative, Conceptually-Themed Introductory Majors Biology Course at a Large, Diverse University

CHRISTIAN D. WRIGHT, BINABEN VANMALI, VALERIE STOUT, MICHAEL ANGILLETTA, CHRISTOFER BANG AND MILES ORCHINIK, *Arizona State University*

To create more scientifically literate citizens and the next generation of researchers, teachers and clinicians, the School of Life Sciences at Arizona State University is transforming its curriculum. We have a multi-pronged strategy for education reform informed by NAS/HMMI Summer Institutes, NRC reports (e.g., *Bio 2010* and *Thinking Evolutionarily*), and *Vision and Change*. We are launching a two-semester introductory biology sequence for majors (BIO 281 & 282). The yearlong course is problems-oriented and built around a limited number of clearly defined learning outcomes and basic competencies, including writing, computation, and nature of science. The course will replace one lecture per week with student-centered activities in a room designed for active learning, and will incorporate additional inquiry-based labs. Lectures will be phased out as we "flip" the courses, with most information transfer occurring outside the classroom. Instructors will use traditional lecture time to confront misconceptions and challenge students to apply course-related concepts to answer real-world, societally relevant questions. The course incorporates adaptive testing to provide frequent assessment and feedback to both the student and the instructor. Additionally, students taking BIO 281 will co-enroll in first-year composition courses and Statistics for Biosciences. We present a more detailed description of the reform efforts for this course.

A Poster 37

Quantitative Learning in Biology Using Peer-Led Learning Groups

ALYSON ZEAMER, *University of Texas, San Antonio*

The University of Texas at San Antonio has adopted a new Quality Enhancement Plan (QEP) to address the critical need for students to master quantitative literacy and reasoning skills and learn to communicate their results to others. In the Biology department, we wanted to expose students to this type of thinking as early as possible, so we've integrated these concepts into the freshman-level Biosciences I course. In addition to the lecture portion of the course, students enroll in a much smaller 1-hour weekly Quantitative Learning (QL) section. Each section has an undergraduate QL Leader trained in small group facilitation, and six groups of 4-5 students each. The goal of each QL Leader is to facilitate peer-led group learning and ensure groups are staying on track and working cohesively. Each week the students have a series of quantitative biology problems which they work together in their small group, and which they then must individually present to the class. The in-class group learning is vital to their comprehension of the material because they must understand the concepts well enough to teach it to their peers. We are currently in our fifth semester of implementing the QL

sessions, and are continually striving to update the content and format of the QLs to fit our students' needs. The poster will describe the challenges we have faced in implementing QL material in a large lecture course, describe the organization of the QL sessions, and give examples of the weekly QL assignments.